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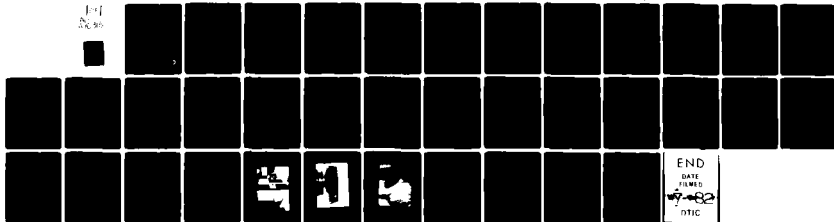
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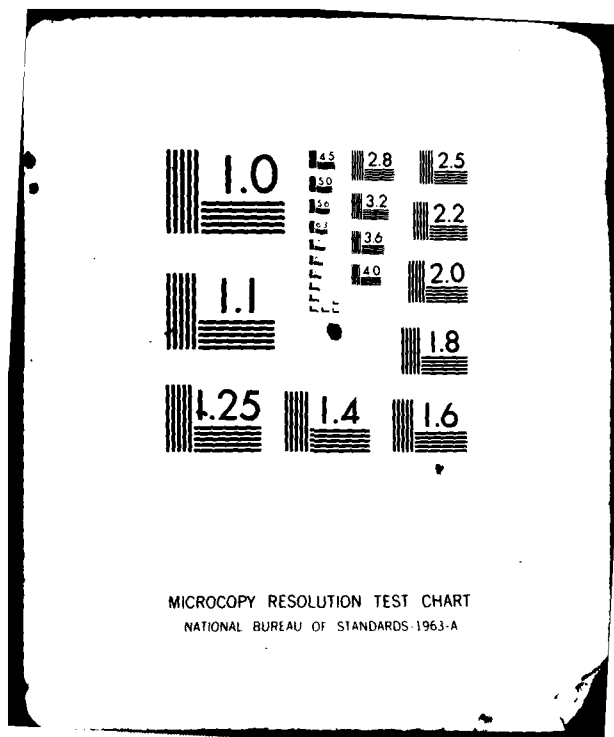
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SPINE - COMMUNICATIONS EARTH STATION OPERATING PROCEDURES

by

K. Green

March 1982

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ROYAL AIRCRAFT ESTABLISHMENT

Technical Memorandum Space 300

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SPINE - COMMUNICATIONS EARTH STATION OPERATING PROCEDURES

by

K. Green

SUMMARY

As part of the Space Informatics Network Experiment (SPINE) the RAE have installed a data communications earth station to be one node of the network. This Memorandum details the operating procedures for this earth station.

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1 INTRODUCTION

As part of the Space Informatics Network Experiment (SPINE) the RAE has installed a satellite communications earth station which consists of a data terminal¹, a channel synchroniser², a computer interface module³ and a SEL '2/77 link driving computer. The data terminal provides the RF carrier and modulation of the transmitted and received signals compatible with Orbital Test Satellite (OTS) operations. The digital data to be transmitted is derived from the link driving computer peripherals (eg magnetic tape unit) and processed firstly by the computer interface module which serialises and formats the data into HDLC frames, and secondly, by the channel synchroniser which performs scrambling/descrambling and data burst formatting functions. This Memorandum gives details for the operation of the station, with particular reference to the SPINE application dedicated to the transfer of remote sensing image data⁴. Data stored at one SPINE network node may be requested and received by any other nodal earth station, and written to computer compatible magnetic tapes (CCT).

Although it would probably be more appropriate to use appendices to contain the setting-up procedures for the earth station, these are given in the main body of the Memorandum whilst appendices have been reserved for such items as the Data Terminal Safety Plan (Appendix A), a description of the Communications Software Operation (Appendix B) and the Data Terminal Test Translator Loop Test (Appendix C). For completeness, although not strictly part of the earth station's operator functions, a description of the ancillary management task of ordering remote sensing data from the ESA Quest⁵ system archives is given in Appendix D.

2 SWITCH-ON PROCEDURE

2.1 Link Driving Computer (LDC)

The LDC installation consists of a central processor, a magnetic tape unit, a disc unit, operator's VDU console and a line printer (Fig 1). These units should be prepared for operation by operating the appropriate wall switches to apply mains power. Without any further action being necessary the extractor fans for the disc unit will be activated. To allow time for this unit to be purged, a wait time of 30 minutes should be allowed before loading the disc cartridge. Following this period the other units may be activated in the following manner:

- (a) Central processor - Ensure that the PANEL LOCK is in the UNLOCKED position. Press the POWER button on the front panel. The panel displays will illuminate.
- (b) Magnetic tape unit - Switch the front panel POWER ON/OFF switch to ON. The indicator marked FPT will illuminate.
- (c) Disc unit - No further action is required until the disc cartridge is to be loaded.
- (d) Operator's console - The ON/OFF switch is situated on the rear panel adjacent to the mains lead entry. Normally however,

the console is left in the ON state, this can be confirmed by the front panel POWER ON indicator being illuminated.

- (e) Line printer - Press the TOP OF FORM button to align the paper.
Press the ONLINE button until it illuminates.

The magnetic tape unit and disc unit should be loaded, with their respective media, for on-line activity by the following procedures:

(i) Magnetic tape loading

Open the cabinet door and load the CCT on to the top hub (ensuring that the write protect ring is in place). Press the catch in the hub centre whilst holding the reel firmly in position. Thread the tape between the read/write heads following the route indicated on the panel front. Ensure the tape lies neatly on the rollers and feed onto the take-up spool. Manually wind the tape onto the take-up spool (clockwise) for a few revolutions. Close the cabinet door. Press 1600 CPI button until it illuminates. Press LOAD/RESET and the tape will automatically load to the correct start position. At the end of this process the LOAD/RESET button illuminates and the FPT indicator extinguishes.

To prepare for on-line activity press the ONLINE button until it illuminates.

(ii) Disc cartridge loading

Holding the cartridge container by the top handle the base should be removed by pinching together the catch at the centre of the base.

Operate the disc unit lid catch to release the lid.

Carefully place the cartridge into position on the spindle and turn the container handle clockwise until tight.

Carefully lift off the cartridge cover.

Close the unit lid and replace the cartridge cover on its base.

Wait one minute and then press the front panel START button.

When the READY indicator stops flashing and is illuminated continuously the disc is ready for operational use.

2.2 Data terminal (Figs 2 and 3)

Before operating this terminal the user should have read the Safety Plan (reproduced in Appendix A). The terminal is normally left in a quiescent state, with most of its units connected to Mains B (see indicator at the top of the cabinet) being permanently powered-up. In order to make the terminal operational, Mains A must be switched on by using the special Cassel lock. Before proceeding ensure that the waveguide switches on the RF unit front panel are switched to the LOAD position (fully clockwise). The following terminal units may then be switched on:

(a) High power amplifier (HPA)

Ensure that the LOW and HIGH VOLTAGE POWER switches are ON (they are normally left in this state). Turn the front panel rotary switch to OPERATE, the yellow TIME DELAY indicator will illuminate. After a delay of a few minutes the blue OPERATE indicator will illuminate; the HPA is now operational.

Because of the high surge currents during switch-on the Mains A may sometimes trip-out due to overload. In this case, the HPA should be switched to OFF, the Mains A circuit breaker re-set and the switch-on procedure for the HPA repeated.

(b) Intermediate power amplifier (Varian power supply)

Press the front panel POWER switch until it illuminates. The BEAM-ON indicator will also illuminate.

(c) Convolutional encoder-Viterbi decoder (Codec)

Press the POWER ON button until it illuminates.

(d) Receive power meter

Press LINE OFF-ON button, which will illuminate to indicate the ON state.

2.3 Channel synchroniser*

Switch on mains power at the wall socket. Switch the unit front panel POWER switch to ON; +VCC1, +VCC2 and -VCC2 indicators will illuminate.

2.4 Computer interface module (CIM)*

Switch on this unit at the mains wall socket. No unit front panel indicator is provided.

3 INTER-CONNECTION CABLES

A schematic block diagram for the communication earth station installed at RAE is given in Fig 4. The cables connecting the various units are shown with their respective markings. These cables are:

data terminal to channel synchroniser
channel synchroniser to CIM
CIM to link driving computer.

Ensure that each cable is attached to the correct unit.

4 EARTH STATION PARAMETER SETTING

Before commencement of data transmission a number of station parameters must be set on the various units. Some of these will relate to the particular mode chosen for transmission and may be subject to variation from those given below. The following information is relevant to the RAE station used as a network node in the SPINE remote sensing data transmission application.

* If these units have been mounted with the magnetic tape unit, power will be applied when the appropriate wall switch for that cabinet is operated.

4.1 Data terminal

(a) RF unit

In the *standby* state the waveguide switches (Rx and Tx) should be set to the load position (*ie* fully clockwise). In this mode local test translator tests may be performed (see Appendix C). When data transmission is required, these switches should be turned to the antenna position (*ie* fully anti-clockwise).

(b) Receive power meter

Select the range -30 dBm.

(c) Modem

The modulator front panel DIFF ENCODER switch should be set to OFF.

The demodulator front panel DIFF DECODER switch should be set to OFF.

(d) Signal monitor

The front panel CARRIER switch should be set to ON and the NOISE switch set to OFF.

(e) Interface unit

Pull out the shelf assembly, which houses the interface module, to gain access to the following internal switches:

DECODER set to IN
CODER set to IN
RTS set to REMOTE.

Check that the front panel coaxial cable links are connected as indicated by the line markings Rx and Tx. No connection should be made to the NOISE IN socket.

(f) Codec

Ensure that the following front panel indicators are illuminated:

ENCODER ~ PSK
ENCODER ~ DIFF CODING
DECODER ~ PSK
DECODER ~ DIFF CODING
QUANTISATION ~ HARD
SELF TEST ~ OPERATE

Key selection for these states may be made on the Codec rear panel which may be accessed through the terminal cabinet rear door.

4.2 Channel synchroniser

Set the following front panel switches:

ACT/PASS to ACT
LOC/REM to LOC.

The settings for D1, D2, SYNC BURST (MASTER/SLAVE), CLK and DATA RATE (500 kHz/1 MHz) depend upon the mode of operation for the transmission and the SPINE nodal station considered. The operator should refer to the communications software output (Appendix B) which gives the initial setting-up parameters currently to be used for a requested mode of operation.

As explained briefly in section 1, the channel synchroniser provides the data transmission link control and burst structuring. By agreement, one SPINE station is designated *master* (in which case their sync burst switch is set to MASTER, whereas all other stations set their channel synchronisers to SLAVE) and this station then transmits a *sync burst*, which all stations (including the master) receive and monitor. The D1 setting for each station is then a measure of time from the end of this received sync burst to the beginning of its transmitted data (or acknowledgment) burst. Data bursts consist of a preamble plus *actual* data; the length of this data is given by the D2 setting. The CLK and DATA RATE parameters are chosen to suit the universally agreed data transfer rate used for SPINE.

4.3 CIM

Set the front panel thumbwheel switches to the required values for the parameter known as D3. This parameter will vary with the mode of operation for the transmission and corresponds to the data length setting D2, its value enables the CIM to determine how many HDLC frames can be fitted into the data burst.

This completes the preparation of the earth station for transmission.

5 LDC OPERATING SYSTEM - BOOTSTRAP LOADING

Before the application communications program⁶ (see section 6) may be loaded and run in the LDC, the computer's operating system must be loaded; the procedure for this is as follows:

Check that the disc unit is loaded and operational (see section 2.1).

If necessary operate the processor front panel RUN/HALT button to HALT the processor (indicated by the illumination of an indicator in the HALT front panel area).

On the processor front panel select the following keys in sequence:

SYSTEM RESET
KEYBOARD
8
0
0
INITIAL PROGRAM LOAD

The HALT indicator should then extinguish and the RUN indicator illuminate.

The following messages will be displayed on the console VDU:

ICL COMPLETE
SYSTEMS
REAL-TIME MONITOR
PSD MODE
INITIALISATION COMPLETE
TERMINAL SET-UP DONE
ENTER DATE AND TIME
▲

The operating system is now loaded and the user is able to activate application software.

If it becomes necessary to re-boot the system, press the RUN/HALT button to HALT the processor and proceed with the keyboard selections as detailed above.

6 COMMUNICATIONS SOFTWARE OPERATION

The communications software, for the link driving computer, controls the high level protocol functions such as establishing the link between network nodes, initialising data transfer, aborting runs and monitoring error conditions. These functions are under the control of operator issued commands at the LDC console. The dialogue between computer and operator keeps the latter informed as to the status of the communications link.

Details of the current version (SPINE version 165) of the software are given in Appendix B, where the dialogue an operator can expect during a data transmission is reproduced. It will be seen fairly early on during this dialogue that the operator is asked to enter a code which will define the run to be undertaken. One such code (FBFBTEST) informs the computer that a station loop test is to be performed. Because of the special interest in this test, from the operations point of view, details of the procedure to be undertaken are given in Appendix C.

7 SPINE EARTH STATION OPERATOR'S REPORT

The operator is expected to complete and file an operator's report during each run of the earth station. Report pro forma are available at the station for this purpose. Fig 5a&b shows the lay-out of this pro forma, where it can be seen that station parameter settings, data terminal operating levels, local weather conditions and details of data transmitted are requested. The operator should also file the line printer output related to the run and enter brief details of data terminal useage in the terminal log book.

8 EARTH STATION SHUT DOWN

The following procedures should be followed for station shut down.

8.1 Data terminal

Turn the waveguide switches on the RF unit fully clockwise to the load position.

Turn the HPA rotary switch to STANDBY and after a delay of a few minutes (no more than 5 min), turn to OFF.

Press the IPA POWER button until it extinguishes.

Press the LINE OFF-ON button on the Receive Power Meter to extinguish.

Press the Codec POWER button until it extinguishes.

Turn off Mains A by operating the Castell lock.

8.2 Channel synchroniser

Switch the POWER switch on the power module to OFF and turn off the mains supply at the wall socket.

8.3 CIM

Switch off this unit by removing power at the wall socket.

8.4 LDC

Halt the processor by pressing the RUN/HALT button as necessary. Press the front panel POWER button until it extinguishes and switch off the mains power supply at the wall switch.

Unload the disc cartridge by the following procedure:

Press the START button and wait until the READY light extinguishes (*ie* stops flashing).

Lift the disc cartridge cover from its base.

Release and raise the disc unit lid.

Place (with care) the cover over the disc cartridge and ensure the three notches engage the slots on the top of the disc cartridge. Turn the handle of the disc cartridge cover anticlockwise until several audible clicks are heard.

Lift out the disc cartridge and close the lid of the unit.

Replace the disc cartridge on the cover base and ensure that it snaps securely shut.

Switch off the mains power supply at the wall switch.

Unload the tape from the magnetic tape by the following procedure:

Press the ONLINE button until its indicator light extinguishes.

Press LOAD/RESET once - no change in the indicator lamp will occur.

Press REWIND and wait for the tape to unload. LOAD/RESET indicator will extinguish and FPT indicator illuminate.

Open the cabinet door and remove the tape from the hub by releasing the centre catch. Close the cabinet, switch POWER ON/OFF to OFF and switch off the mains power supply wall switch. Label the tape container as appropriate.

Switch off the mains power supply to the line printer and VDU console at the wall sockets.

9 CONCLUSIONS

The Memorandum contains all the relevant and ancillary information for the operation of the SPINE earth station installed at RAE. It has not been assumed that the operators will have responsibility for correction of hardware or software faults, although references have been given to documents which would allow this to be undertaken.

Appendix A

SAFETY PLAN FOR THE TERMINAL INSTALLED AT RAE, P160 BUILDING

A.1 Introduction

The following instructions should be fully implemented by all personnel engaged in the operation or maintenance of the Satellite Communications Data Terminal (referred to as the Terminal) at present installed in P160 Building. In addition, all personnel who are likely to require access to the immediate vicinity of the equipment which constitutes the Terminal, for whatever reason, should also strictly observe these instructions.

A.2 The Terminal installation

The Terminal basically is formed of two parts, a single 6ft cabinet housed in Room 219 and a 3m diameter antenna dish mounted on the eastern roof area of P160 Building. Fig A1 shows the general layout for this hardware. Interconnection between the two parts is via a waveguide through the ceiling of Room 219. Other connections to the equipment are: power and computer interface cables to the cabinet, and power cables (for anti-icing heater pads), and earthing straps (for lightning protection) to the antenna. None of these connections will be dismantled on a day to day basis. The Terminal is to be used for transmission and reception of signals from satellites. Initially it is intended for communications with the European Orbital Test Satellite (OTS), which is in geostationary orbit, 10° east over the equator. This means that the antenna will be set up for normal operations in a fixed position, approximately 30° elevation, 167° east of north azimuth.

A.3 Hazards

Sources of hazards, over and above that normally associated with electronic racked equipment, can be said to exist from: RF radiation, the physical dangers whilst working on the antenna, high voltage and beryllium products.

(a) RF radiation

Sources for RF radiation are:

- (i) the waveguide runs in the cabinet, and between the cabinet and the antenna
- and (ii) in front of the antenna dish.

During installation of the Terminal, the waveguide runs are checked for leakage such that any detected radiation which exceeds 1 mW/cm^2 whilst the Terminal is radiating at full power is eliminated. If, for whatever reasons, the waveguide flanges are disturbed, a check should be carried out, by the designated Installation Safety Officer with a suitable hazard meter* to confirm that this standard is maintained. The procedures detailed in the Terminal Manual (MCSL Publication No. CT 2035) should be followed when work on the waveguide is necessary.

The Terminal should never be used in a transmitting mode unless the waveguides are correctly terminated at the antenna, or into a suitable absorbing load.

* A suitable meter may be borrowed from Aircraft Department (Mr T. Davies) for this purpose.

The antenna dish itself is the second source of RF radiation. The rear of the antenna is checked during the installation to confirm that the 1 mW/cm^2 criteria is not exceeded. Field strengths above this level are however, present in the dish front area, and for this reason the roof area in front of the antenna should be regarded as a prohibited area during actual transmission periods.

Never look in an open waveguide or the antenna dish whilst the Terminal is in operation.

(b) Physical dangers

Because of the necessary siting arrangements for the antenna on the roof of P160 building, there are the obvious dangers associated with working in this type of environment. The antenna has been sited as far back on the eastern flat roof section as is practicable. The rails at the perimeter of this roof area have been improved, so as to provide an adequate safety barrier. However, if there is a requirement to work in the face of the dish, whilst the antenna is in the elevated position, this will probably require the use of step ladders (or similar arrangements), hence a safety harness anchored to the antenna frame should be worn. A suitable harness and lanyard are stored in the adjacent plant room for use in these circumstances.

(c) High voltage hazard

Two units in the terminal cabinet contain high voltage sources, these are:

- (i) the high voltage amplifier inside of which up to 7.5 kV can be present, and
- (ii) the power supply for the 10W travelling wave tube in the RF unit, which generates up to 4.5 kV. Adequate precautions and warning notices have been incorporated in the equipment design, but personnel should not ignore the fact that these high voltages are present.

(d) Beryllium products hazard

The high power amplifier travelling wave tube contains beryllium oxide ceramic parts which are only accessible if the metal casing of the tube is damaged or removed. The beryllia safety precautions appending the Terminal Manual (CT 2035) should be referred to for information* on the hazards involved, and the precautions to be exercised. However, it is worth noting here that:

- (i) Beryllia parts should be handled only with gloves, and preferably with tweezers.
- (ii) No filing, abrading, machining or heating should be permitted and care should be taken not to allow beryllia parts to contact each other.
- (iii) Inhalation of dust or fumes from beryllia is the principal hazard, but particles penetrating skin will cause injury and should be countered by immediate washing.

*Refer also to Health and Safety Executive Guidance Note EH13 - "Beryllium - health and safety precautions" - dated October 1978

A.4 Operating Safety Plan

(a) Installation Safety Officer

Nomination of a Space Department Installation Safety Officer (ISO) and his deputies will be the responsibility of the Administration Office, Space Department. This officer will be required to ensure that all safety procedures are adhered to and that these instructions are brought to the attention of all personnel likely to require access to Room 219, P160 building, and the roof area of P160 building. He shall also be required to carry out periodic checks on any safety devices or aids, so as to ensure that they operate in accordance with these instructions. The ISO's name and location should be posted in Room 219, P160 building.

A.5 Safety aids

(a) Castell lock

A Castell lock is fitted to the door at the bottom of the roof access staircase (in Room 201). The key for this lock can only be obtained by switching off mains supply A to the Terminal cabinet. This action prevents the transmitter from operating, and therefore renders the roof area safe from radiation hazard. The key can only be removed under the supervision of the Officer-in-Charge of the Terminal (or alternatively the ISO). Particular care should be taken to follow the switching off instructions attached to Mains A supply as considerable damage to the Terminal could result if these instructions are not obeyed. After access to the roof area, the person who requested the Castell lock key should return the key to the Officer-in-Charge of the Terminal and report that he has done so to the ISO.

(b) Roof area clearance

It is the responsibility of the person who gains access to the roof (*ie* that person who obtained the Castell lock key) to ensure that the whole roof area, plant room and building ventilation space is clear of all other personnel before locking the staircase. To aid this procedure the access doors to the western roof area (from the head of the staircase) the eastern roof area (from the plant room) ventilation area (from the plant room) and the ventilation area (from the eastern roof area) are all locked and the keys for these locks are held by the ISO. The person requiring access to the roof may obtain these keys and maintain control over their use while on the roof. This should enable him to monitor movements of other personnel in the various areas of the roof. These keys should be returned to the ISO immediately after use.

(c) 'Transmit Warning' and 'Safe to Enter' lights

Red warning lights which illuminate when the terminal is transmitting, and green 'safe to enter' light are fitted to the external plant room wall, on the inside wall adjacent to the plant room exit door and the access staircase. If both these lights are inoperative, the reason should be investigated before entering the antenna roof area; as the electrical supply for these lights is taken from the load side of the consumer supply the reason may be that this supply has been interrupted at, or before, the consumer panel, or that a bulb failure has occurred.

(d) Hazard notices

Radiation hazard notices are displayed on all access doors to the eastern roof area, the roof of the plant room (facing west), on P160 Building south facing wall (as near the antenna as possible) and finally a free-standing notice is situated on the eastern flat roof area.

Waveguide runs for the transmit system are marked with hazard warning notices.

(e) Antenna movement limitations

Azimuth and elevation movement is possible for the antenna dish by manual means only. The design of the antenna frame precludes movement of more than $\pm 25^\circ$ in either plane, from the original installation installed position. Even so, only this can be achieved by unbolting the coarse adjustment facilities. Fine adjustment for the antenna movement is limited to $\pm 7^\circ$ and to undertake this, large nuts requiring a special spanner need to be adjusted. This spanner should be kept by the ISO so that no adjustments are possible without his knowledge or authority. As an additional precaution the adjustment nuts are drilled and locked with wire.

(f) Waveguide/pressurisation

The waveguide runs from cabinet to antenna are pressurised with dry air at 0.5 to 1.0 psi. The interval between which the pressure pump is on gives an indication of the leak rate for the system, hence, in the event of a waveguide being open, this pump will operate continuously - this gives a gross means of checking that waveguide flanges have not been opened.

At no time should the waveguide flanges be opened whilst the transmitter is on; and similarly, the transmitter should not be switched on whilst a waveguide flange is open. Flanges and flange units are painted after initial installation, or following any authorised disturbance of the joints. No external physical loads should be placed on the waveguide runs as this might result in damage and the possibility of RF radiation escape.

(g) Officer-in-Charge of the Terminal

At no time will the Terminal be operated without a designated officer being present who accepts responsibility for its operation.

A.6 Special procedures for Terminal maintenance and installation

During installation and possibly maintenance, of the Terminal, there will be a requirement for engineers to access the eastern roof area whilst the Terminal is transmitting. This will require personnel to be locked on the roof area and therefore special procedures should be followed. These require that during transmit periods:

- (i) there is a temporary field telephone link between the eastern roof area and Room 219,
- (ii) Room 219 must be manned at all times during which engineers are on the roof,
- (iii) Engineers should not walk in front of the antenna dish.

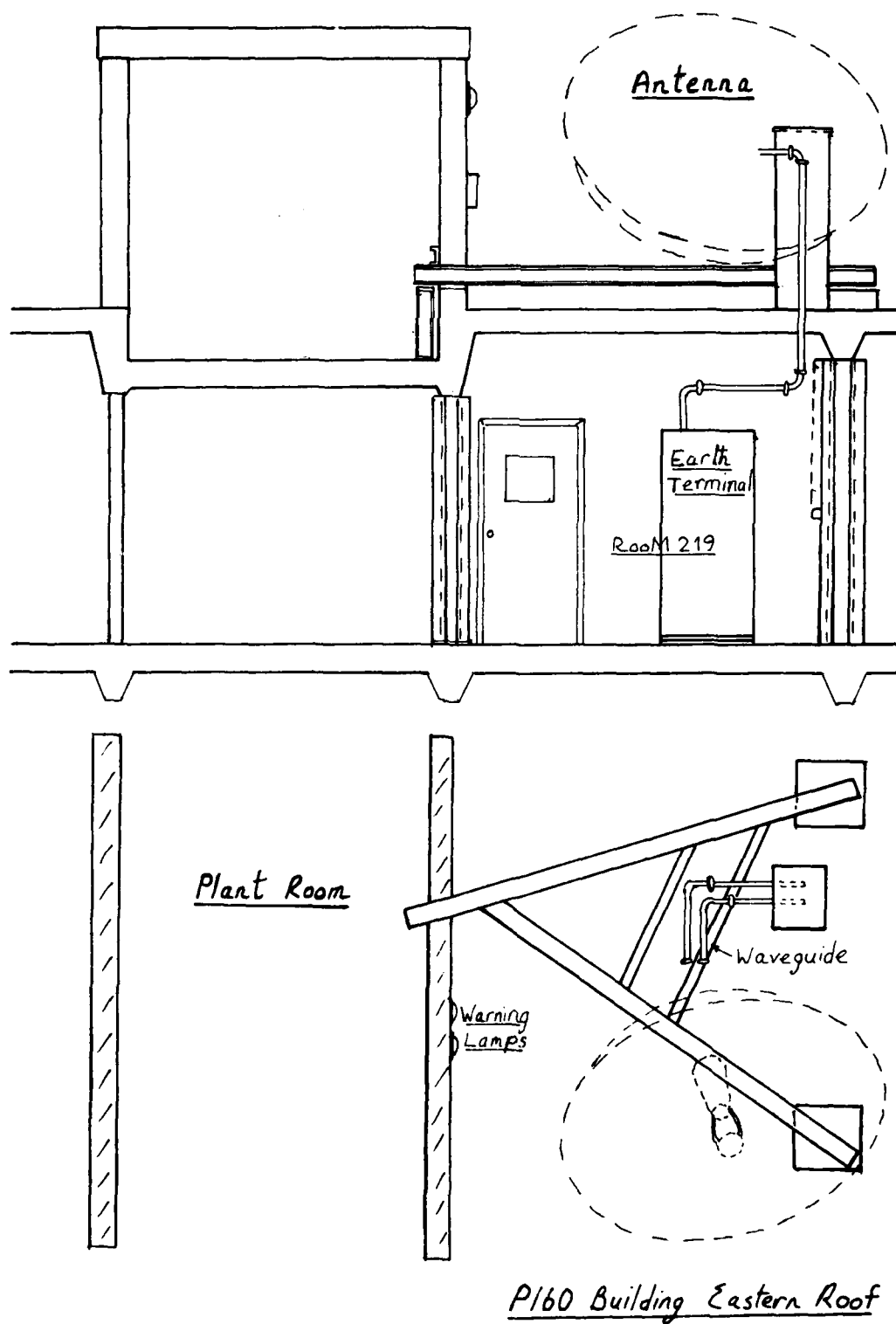


Fig A1 P160 installation layout

Appendix B

COMMUNICATIONS SOFTWARE OPERATION

The communications program SPINE enables users of the RAE Earth Station to set-up and control a communication link between the RAE site and remote European establishments. It is primarily designed for the transfer of digital data in file form, magnetic tape to magnetic tape. The following dialogue shows the operator actions and computer responses during a program run for the transmission of data from ESRIN (Frascati, Italy) to RAE.

Following the preparation of the earth station and loading of the computer operating system, the operator may activate the program by pressing the ATTENTION button on the processor front panel and, in response to the VDU display ??▲, typing

ACTIVATE SPINE)

(Take the symbol) to mean - type RETURN.)

The program response is:

```
SPINE COMMUNICATIONS PROGRAM - VERSION  nnn
SPACE DEPT. RAE, FARNBOROUGH, HANTS. UK.  Date
PRINT OUT REQUIRED Y, N? - Y▲
```

(This is the general format for questions from the program; in this case, type) if a printout is required on the line printer or otherwise, N) to indicate no printout is required. If the line printer is not ONLINE when output is requested, the message *LP7A INØP: R:A? is displayed. This allows the operator to ONLINE the printer and type R) to resume or to abort the run by typing A) .)

Hence for example:

Type N)

The response is:

```
ENTER CODE FOR THIS RUN OR <CR> FOR LIST OF CODES ▲
( <CR> means RETURN on the console keyboard)
```

Type)

The response is:

CODE	THIS STATION	REMOTE STATION	OPERATION
FBFARM2	FARNBOROUGH	FARSTA	RECEIVE AND MESSAGES
FBFASM2	FARNBOROUGH	FARSTA	SEND AND MESSAGES
FBFRRO2	FARNBOROUGH	FRASCATI	RECEIVE ONLY
FBFRSO2	FARNBOROUGH	FRASCATI	SEND ONLY
FBKRRM2	FARNBOROUGH	KIRUNA	RECEIVE AND MESSAGES
FBKRSM2	FARNBOROUGH	KIRUNA	SEND AND MESSAGES
FBFBTEST	FARNBOROUGH	FARNBOROUGH	LOOP TEST

CONTINUE RUN OR TERMINATE C,T? - C ▲

To continue run type:)

The response is:

```
ENTER CODE FOR THIS RUN OR <CR> FOR LIST OF CODES ▲
```

For example, type:

EBFRRO2)

The response is:

```

CODE      THIS STATION  REMOTE STATION  OPERATION
FBFRRO2   FARNBOROUGH  FRASCATI       RECEIVE ONLY
PREPARED ON 28 JANUARY 1982
OWN ADDRESS = 17 (NORTHERN), REMOTE ADDRESS = 18 (SOUTHERN)
ASSUME : OWN RANGE=257MS : TIME FRAME=252MS
D1=224-257+252=219MS=333(OCTAL)
CHANNEL SYNCHRONISER :
D1      (219MS) - 333 (OCTAL) - SWITCHES 7,6,4,3,1,0 UP
D2      ( 20MS) - 024 (OCTAL) - SWITCHES 4,2 UP
DATA RATE      - 500 KHZ
MASTER/SLAVE   - SLAVE
2X/1X CLOCK    - 2X
COMPUTER INTERFACE MODULE :
D3            - 00F3 (HEX)
MODEM :
DIFF ENCODER   - OUT
DIFF DECODER   - OUT
CONV ENCODER   - IN
CONV DECODER   - IN

```

INITIAL SETTING UP COMPLETED - C,T? - C ▲

After checking that these station parameters are set correctly, the run may be continued by typing: ↵

The response is:

```

PRESS ATTENTION AND TYPE HELP FOR LIST OF COMMANDS
INITIALISATION COMPLETE ▲

```

Press ATTENTION on processor front panel.

The response is:

CMD ??

(This is the normal invitation for the operator to issue a program command, after typing HELP a list of operator commands will be displayed. Each command has, in addition to normal operation, associated error messages which are output to prompt operator action.)

Type: HELP ↵

The response is:

```

LINK CLOSED
NO FILE TRANSFER IN PROGRESS
COMMANDS AVAILABLE
OPEN      - OPEN THE LINK
CLOS(E)   - CLOSE THE LINK
RECE(IVE) - RECEIVE A FILE (TAPE)
ABOR(T)   - ABORT TAPE TRANSFER
FINI(SH)  - FINISH RUN OF PROGRAM ▲

```

(This command list is different for each run code selected, for example, FBKRSM2, FBFASM2, FBFBTEST, FBKRRM2 and FBFARM2 have the additional facility which allows the operator to send a message over the link by use of the command MESS(AGE); whereas FBKRSM2, FBFBTEST, FBFASM2 and FBFRS02 allow a datafile to be sent over the link by using the command SEND.)

Press ATTENTION and type required command. The response to each command is detailed below.

OPEN command

Type: OPEN ↵

The response is:

ATTEMPTING TO OPEN LINK
LINK OPENED ▲

(If all the elements for forming the link are not present, then the response would be:

ATTEMPTING TO OPEN LINK
FAILED TO OPEN LINK ▲

Other error conditions are monitored for which the appropriate response is:

TX TIMEOUT-D2 TOO SHORT?-CIM OR CH SYNC OFF?

This message is continuously repeated until ATTENTION is pressed.)

CLOSE command

Type: CLOS ↵

The response is:

ATTEMPTING TO CLOSE LINK
LINK CLOSED
INITIALISATION COMPLETE ▲

(or if link is not open)

CLOSE COMMAND IGNORED - LINK NOT OPEN ▲

RECEIVE command

Type: RECE ↵

If the link is not open then the response is:

RECEIVE COMMAND IGNORED - LINK NOT OPEN ▲

Otherwise, the response is:

ENTER REMOTE FILENAME ▲

The format for FILENAME is one of the following:

SPINE.C160mcc.Ittffs for MSS (CCT) data
SPINE.Q160mcc.Ittffs for quicklook data
SPINE.R160mcc.Ittffsq for RBV data

where m is the LANDSAT mission number (1, 2 or 3)
cc is the cycle number (hexadecimal)
tt is the orbital track (or path) number (hexadecimal)
ff is the image frame (or row) number
s is the archive station number, 0 for Fucino
1 for Kiruna
and q (for RBV data only) is the quadrant number.

Type: 'FILENAME'

If this file is available at the remote site, the response is:

```
REMOTE FILE OPENED
IS TAPE LOADED ON UNIT 0 R,A?-R ▲
```

Type *↵* to continue or *A)* to abort the run. If *↵* is selected the file will commence to be transferred, and upon completion, the magnetic tape will re-wind to the load position and the following console messages will be output:

```
NORMAL REMOTE END OF FILE
MAG TAPE - n RETRIES
REMOTE FILE CLOSED
LOCAL FILE CLOSED

***** TRANSFER SUCCESSFUL *****
RECEIVED - x FILES, yyyy BLOCKS - MAX LENGTH zzzz BYTES
END OF TRANSFER ▲
```

If the named file is not available at the remote site the response is:

```
***** TRANSFER FAILED *****
ERROR - FAILURE IN OPENING REMOTE FILE
END OF TRANSFER ▲
```

ABORT command

Type: ABOR *↵*

When data is being transferred the response is:

```
FAILURE IN WRITING LOCAL FILE
MAG TAPE - n RETRIES
WAITING TO CLOSE REMOTE FILE ▲
```

or is if no transfer is in progress, the response is:

```
ABORT COMMAND IGNORED - NO TRANSFER IN PROGRESS ▲
```

MESSAGE command

Type: MESS *↵*

If the link is open the response is:

```
ENTER MESSAGE - FIVE LINES MAX - <CR> TO TERMINATE
MESS 1 >
```

Type the message followed by *↵*

Response is: MESS 2 >

Type the next message or *↵* to terminate the command. (A message may be received at any time that the link is open, the format at the VDU console is:

```
***** MESSAGE RECEIVED *****
```

followed by the message from the remote site.)

SEND command

Type: SEND ↵

The response is:

ENTER REMOTE FILENAME ▲

Type: 'FILENAME'

The response is:

WAITING TO OPEN REMOTE FILE
APPLICATION PROCESSES ACTIVE - STOP THEM?Y,N-Y ▲

Type: N ↵

The response is:

REMOTE FILE OPENED
LOCAL FILE OPENED
DOES TAPE END WITH A DOUBLE FILEMARK Y,N ?-Y ▲

If not:

Type: N ↵

The response is:

ENTER NUMBER OF FILES -

Type: "Number of files to be transferred"

Otherwise, if a double file mask is present,

Type: ↵

The response is:

IS TAPE LOADED ON UNIT 0 R,A?-R ▲

Type: ↵ to continue or A) to abort the process. If ↵ is selected the files will commence to be transferred. Upon completion the magnetic tape will rewind to the load (unload) position. The following messages will be output at the VDU:

NORMAL LOCAL END OF FILE
MAG TAPE - n RETRIES
WAITING TO CLOSE REMOTE FILE
REMOTE FILE CLOSED
LOCAL FILE CLOSED
*****TRANSFER SUCCESSFUL*****
SENT - x FILES, yyyy BLOCKS - MAX LENGTH zzzz BYTES
END OF TRANSFER ▲

-
- NOTES: 1 The format for 'filename' is SPINE.Q160.REC1 for quicklook tapes, SPINE.C160.REC2 for MSS tapes or SPINE.R160.REC3 for RBV tapes when tapes are to be sent.
- 2 If the MESS or SEND command is not available under the run code being used the message output is:
- COMMAND IGNORED DUE TO PARAMETER SETTINGS.

FINISH command

Type: FINI ↵

The response is:

SPINE COMMUNICATIONS PROGRAM - RUN FINISHED ▲

Press ATTENTION and the user is returned to the computer operating system, with the VDU message ??▲

Additional commands available to the operator are:

D3SETTING

This returns the correct value of D3 given the value of D2.

Type: D3SE

The response is:

ENTER D2 IN OCTAL ▲

Type (for example): 005 ↵

The response is:

D2 = (OCTAL) - D3 = 0033(HEX) ▲

PRIVILEGE

This allows the operator to access further commands which are normally only available to software engineers. However, in the event of an undefined halt to data transfer it is useful, from the diagnostic point of view, to obtain a listing of the last frames received before the breakdown. This may be achieved by issuing a Z command after the PRIV command.

Type: PRIV ↵ Press ATTENTION

Type: Z ↵

A VDU screen full of diagnostic information of the following format is output at both the console and the line printer:

-----START OF RECEIVE SNAP-----

0011F60A	RECD	I	123	5		949	0	14.104
0011F40A	RECD	I	122	5		949	0	14.044
0011010A	RECD	S RR		5		1	0	13.044
001201EA	ECHO				S RR 117	1	0	13.964
001201E8	ECHO				S RR 116	1	0	13.964
0011F20A	RECD	I	121	5		949	0	13.924

Where the data field of this format may be designated numbers, for definition purposes, as follows:

1	2	3	4	5	6	7	8	9	10	11	12
---	---	---	---	---	---	---	---	---	----	----	----

where

Field 1

The third and fourth characters of this field are the station addresses.

Field 2

RECD or ECHO indicates that the information for that line relates to data frames received or transmitted by the station addressed in field 1.

Field 3

The characters I or S indicate the data frame type, I for information or S for supervisory. An additional character, U, is possible, this means the frame is unnumbered.

Field 4

RR indicates that the receive station is ready. If the receiver is not ready RNR would appear in this field. In addition, REJ could appear in this field; this means that the receive station has asked for a retransmission, starting from the frame given in field 5.

Field 5

This field contains the frame sequence number (module 128) of the frame received.

Field 6

This field contains the Master Receive sequence number.

Field 7

As for field 3.

Field 8

As for field 4.

Field 9

This field contains the frame sequence number of the next frame requested at the receive station.

Field 10

This field contains the number of 32-bit words in the block (frame) received.

Field 11

Undefined.

Field 12

This field contains a timing counter in seconds. Note that although the information begins with the message - START OF RECEIVE SNAP -, the first line actually contains data related to the *last* frame received when the snap was requested.

In the event of a CRC failure the fields 2 through to 9 are replaced by a message of the type:

CRC FAILURE 03F2

At the end of 22 lines of *snap* output (*ie* a VDU screen full), the operator has the opportunity to request further output by responding to the console query:

CONTINUE SNAP Y,N?-Y

by typing *Y* to continue or *N* if no further output is required. This query will be repeated until the 'SNAP' buffer is emptied (210 seconds worth of transmission).

Run time status messages may be output by the program, these do not interfere with the transmission process and relate to detected errors occurring over the link. The format for these VDU messages is, for example:

CRC FAIL 0 REM 0 OWN 116 OTHERS 116 TOTAL

Interpretation of this message is that the logic circuits of the CIM have detected a cyclic redundancy check error (or block of errors) in the HDLC frame. The occurrence of this message during a data transfer should not cause the operator any concern (unless is is continuously output at the VDU), but for diagnostic purposes the operator should quickly press ATTENTION, issue a PRIV followed by the Z command, and continue the snap to its completion. Note that it is unnecessary to precede subsequent Z commands with the PRIV command. The operator should retain and file the lineprinter output for each transmission run.

Appendix C

DATA TERMINAL TEST TRANSLATOR LOOP TEST

The data terminal has the facility by which a test loop may be set up without the necessity for using satellite time. The terminal can thereby be set to direct transmit data, via special test translator circuits, through the receive chain of the terminal, to complete a loop for test purposes. The following sections describe how the earth station can be prepared for such a test, and also how the operator may use the special software facilities to enable a pre-transmission test to be undertaken.

Complete the switch-on procedure for the earth station (sections 2 and 3). Station parameter settings for a test translator loop test require the following differences from the normal (section 4).

(a) The data terminal RF unit waveguide switches should be set to the load position (*ie* fully clockwise).

(b) The channel synchroniser:

D1 set to 001 (octal), *ie* switch 0 up.
D2 set to 346 (octal), *ie* switches 7, 6, 5, 2, 1 up.
The master/slave switch set to master.

(c) The CIM, D3 set to 0B73 (Hex).

Bootstrap the LDC operating system in the normal way (section 5) and activate the program SPINE (Appendix B) as follows:

Press: ATTENTION on processor front panel.

Type: ACTIVATE SPINE ↵

Response:

```
SPINE COMMUNICATIONS PROGRAM - VERSION 105
SPACE DEPT. RAE, FARNBOROUGH, HANTS. UK. 24 JULY 1981
PRINT OUT REQUIRED Y,N?-Y ▲
```

Type: ↵

Response:

```
ENTER CODE FOR THIS RUN OR <CR> FOR LIST OF CODES ▲
```

Type: FBFBTEST

Response:

```
CODE      THIS STATION  REMOTE STATION  OPERATION
FBFBTEST  FARNBOROUGH   FARNBOROUGH    SELF TEST
ASSUME :   OWN RANGE=257MS : TIME FRAME=248MS
D2 STARTS AT 1 ON MODEM LOOP
D2 STOPS AT 1+230+2=233 ON MODEM LOOP
D2 STARTS AT 1+257-248=10 ON SATELLITE LOOP
D2 STOPS AT 1+230+2+257-248=242 ON SATELLITE LOOP
CHANNEL SYNCHRONISER :
D1        ( 1MS)    - 001 (OCTAL) - SWITCH 0 UP
D2        (230MS)   - 346 (OCTAL) - SWITCHES 7,6,5,2,1 UP
DATA RATE          - 500 KHZ
```

```

MASTER SLAVE          - MASTER
2X/1X CLOCK           - 2X
COMPUTER INTERFACE MODULE :
D3                     - 0B73 (HEX)
MODEM :
DIFF ENCODER           - OUT
DIFF DECODER           - OUT
CONV ENCODER           - IN
CONV DECODER           - IN
COMMAND SEQUENCE ; ACTI,T4GO,Y,INAC,FINI
                     OR : ACTI,GEGO,Y,T2GO,INAC,FINI
INITIAL SETTING UP COMPLETED - C,T ? - C

```

Type: ↵

Response:

```

PRESS ATTENTION AND TYPE HELP FOR LIST OF COMMANDS
INITIALISATION COMPLETE ▲

```

Press ATTENTION

For the first command sequence:

Type: ACTI ↵

Press ATTENTION

Type: T4GO ↵

Response:

```

APPLICATION PROCESSES ACTIVE - STOP THEM?Y,N-Y ▲

```

Type: ↵

Response (for example):

```

BYTE NO. 0 FILLER 00000000
144 ( 144) FRAMES RECEIVED

```

```

BYTE NO. 0 FILLER FFFFFFFF
149 ( 293) FRAMES RECEIVED
150 ( 443) FRAMES RECEIVED

```

```

BYTE NO. 0 FILLER AAAAAAAA
147 ( 590) FRAMES RECEIVED
150 ( 740) FRAMES RECEIVED

```

```

BYTE NO. 0 FILLER 55555555
149 ( 889) FRAMES RECEIVED

```

This output is a record of a sequence number and data pattern test generated by the software; each byte of a 32-bit word is filled with the pattern indicated in turn; the data frames sent are of 1 word length.

From the operations point of view the interpretation of these messages is of little importance, it is only when an error message is output that the operator should seek engineering/software support.

Press ATTENTION (to stop the output)

Type: INAC ↵

The buffer which contains the above output data is emptied and the list terminated by:

INITIALISATION COMPLETE ▲

Press ATTENTION

For the second command sequence:

Type: ACTI)

Press ATTENTION

Type: GEGO)

Response:

APPLICATION PROCESSES ACTIVE - STOP THEM?Y,N-Y ▲

Type:)

Press ATTENTION

Type: T2GO)

Response (for example):

38 FRAMES RECEIVED
12 FRAMES RECEIVED
12 FRAMES RECEIVED
12 etc

The output will continue until ATTENTION IS PRESSED. This test generates 1000 word frames in which the pattern is changed by one bit sequentially; the aim is to check for CRC errors occurring over the loop. Any messages generated other than those of the format given above should be reported to the engineering/software support.

Press ATTENTION

Type: INAC

The buffer holding the above output is emptied and the message: INITIALISATION COMPLETE ▲ is output.

Press ATTENTION

Type: FINI

Response:

SPINE COMMUNICATIONS PROGRAM - RUN FINISHED ▲

Appendix D

LANDSAT PRODUCT ORDERING

A number of different types of remote sensing data products may be obtained from the European Space Agency EARTHNET archives for transmission over the SPINE network. The products currently available to this facility are Landsat Quicklook, Multi Spectral Scanner (MSS) and Return Beam Vidicon (RBV) images.

There are two dial-up procedures which may be used to access the computer catalogue (LEDA file) and archives at the ESA Information Retrieval Service (IRS) facility at ESRIN. One is via the EURONET on-line information retrieval and communications network and the other is via the ESA service known as DIALTECH⁷.

The EURONET procedure requires users to hold a Network Users Identity in addition to the special password necessary to access the IRS computers. EURONET does not recognise the experimental nature of SPINE (unlike DIALTECH) and makes a charge for network use; however, consideration should be given to this service as a back-up to the DIALTECH system. Further information on EURONET may be obtained from their Customer Services (Tel 01-606-9716).

It is recommended that, for ordering Quicklook and MSS products to be transmitted via SPINE, DIALTECH is used as this provides direct access to IRS and no charge is made for the service. On-line connection may be made via low cost terminals (hard copy tele-types or VDU) with modems and telephone availability. The telephone number required to access DIALTECH from the UK is: 0689-36991.

Upon gaining access the computer response is:

PLEASE TYPE A CARRIAGE RETURN

Type: ↵

(The symbol ↵ is used to signify carriage return.)

Response is:

YOU ARE NOW CONNECTED TO RECON
DIALTECH Date
PLEASE ENTER YOUR ESA-QUEST PASSWORD.

Type: SPNO1600 ↵

(This is the special password to be used for all orders to be processed and transmitted via SPINE.)

Response is:

■■■■■■■■ Connection accepted in file 13 12:41:13
Port = 228 - R : Quest language selected

Type: ORDER ↵

Response is:

EARTHNET ORDER FACILITY AT YOUR SERVICE. PLEASE ANSWER THE FOLLOWING
QUESTIONS

CODE FOR PRODUCT TYPE -

(This code may be up to 3 digits in length, if it starts with the letter Q or number 1 a Quicklook product is implied, otherwise a MSS computer compatible tape (CCT) is implied.)

Type: C

Response is:

ACCESSION NO. (MCCTFFS) -

[Here the user is requested to enter the accession number for the product required. The format for this number is:

M is the Landsat mission number
 CC is the cycle number in hexadecimal
 TT is the orbital track (or path) number in hexadecimal
 FF is the image frame (or row) number
 S is the archive station code number, ie 0 for Fucino
 and 1 for Kiruna

This accession number should be terminated with the letter C.]

Hence, for example, type: 14FD9260C

Response is:

ORDER FOR DATASET SPINE.C16014F.ID9260
 TRANSMIT TO 160 AT 14.03 GMT ON 28-07-81

(The QUEST system recognises the RAE Earth Station as being terminal 160.)

To terminate the run type: LOGOFF

Response is:

----- 28 Jul 81 12:59:37 User 0160 -----
 4.71 AU 4.04 min in File 13
 1.35 AU Telecomm charge
 6.06 AU approx total

ESA-QUEST SESSION TERMINATED AT 12:59:45.

The following error messages may be generated during the ordering run:

ORDER NUMBER SYNTAX ERROR	- check accession number format
NOT IN FILE	- the specified accession number is not contained in the catalogue
INVALID COLLECTION NUMBER	- enter the command BEGIN 13 and retry the .ORDER command
EXTERNAL FILE I/O ERROR	- the user station number used in the password is not recognised
COMMAND NOT ACCEPTED/PLEASE REENTER	- command format incorrect
NO TRANSMISSION SCHEDULE AVAILABLE	- there is insufficient remaining scheduled time for transmission of the product to this station.

Any other messages should be relayed to IRS for software support.

Messages may be transmitted to the SPINE network controller at ESRIN by typing the command:

M101/ ----- characters of message -----)

Messages from the SPINE network controller at ESRIN will be received in the format:

MSG FROM 101: --- characters of message ---

Any correspondence related to the product should quote the Dataset reference given in the dialogue above, *eg* SPINE.C16014F.ID9260. This reference is exactly the same as the *filename* required when issuing the RECE command during a SPINE data transfer (Appendix C).

RBV products are ordered via telex by the National Point of Contact (NPOC) manager in Space Department, RAE (Ext 3918). As it seems likely that facilities will be introduced to enable RBV ordering via QUEST, the NPOC manager should be consulted for the current procedure.

REFERENCES

<u>No.</u>	<u>Author</u>	<u>Title, etc</u>
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4	ESA/DFLVR/RAE	Proposal for a computer communication experiment using high speed digital satellite links. March 1979
5	-	QUEST User Manual. Information Retrieval Service, ESRIN, November 1979
6	D.R. Mullins	SPINE: Communications Software. (To be published)
7	-	Dialtech User Manual, Vols. 1 and 2, May 1980

THIS REPORT IS NOT TO BE REPRODUCED
OR TRANSMITTED IN ANY FORM OR BY ANY MEANS
OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEMS

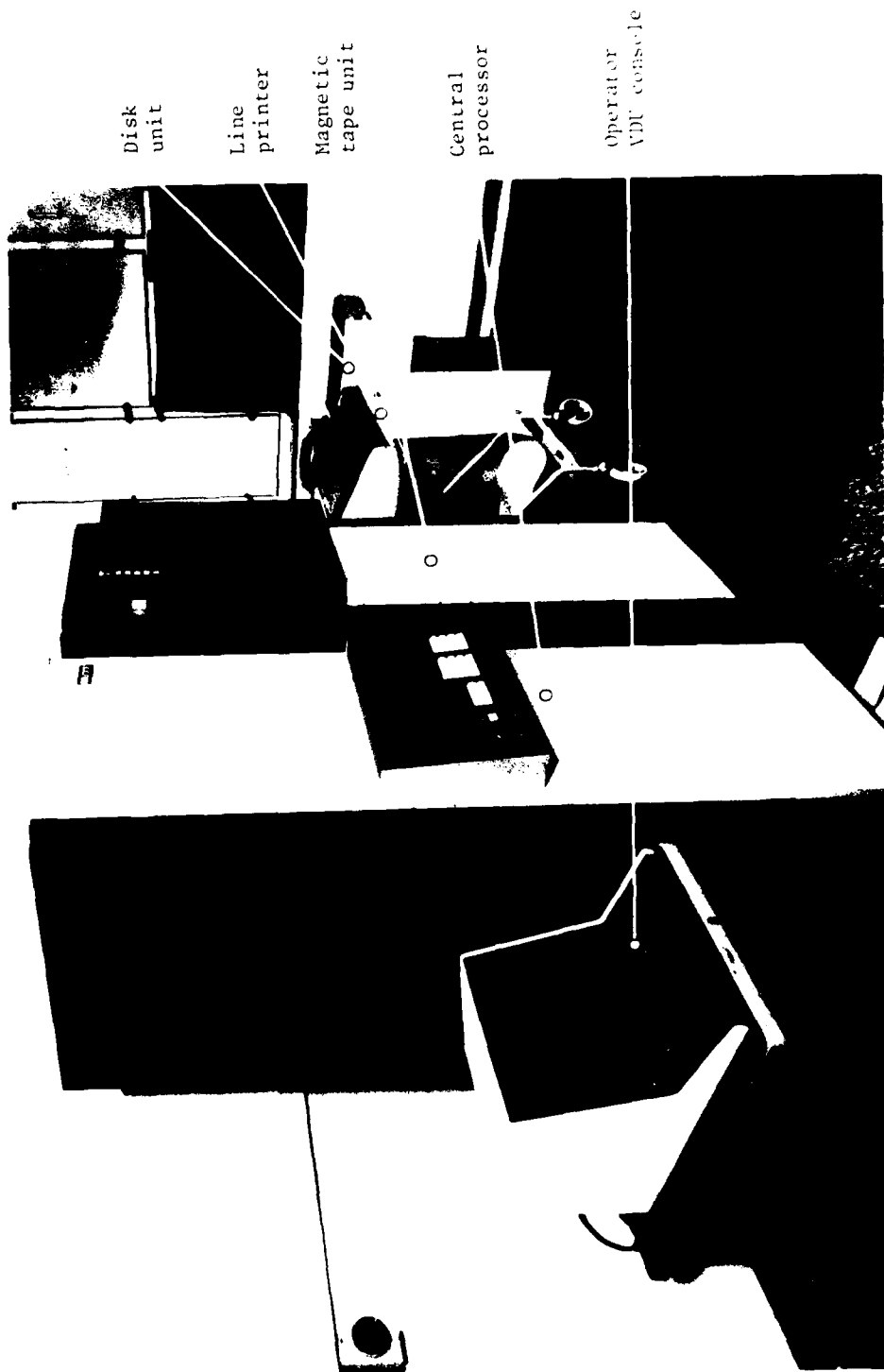


Fig 1 Earth station link driving computer

Fig 2

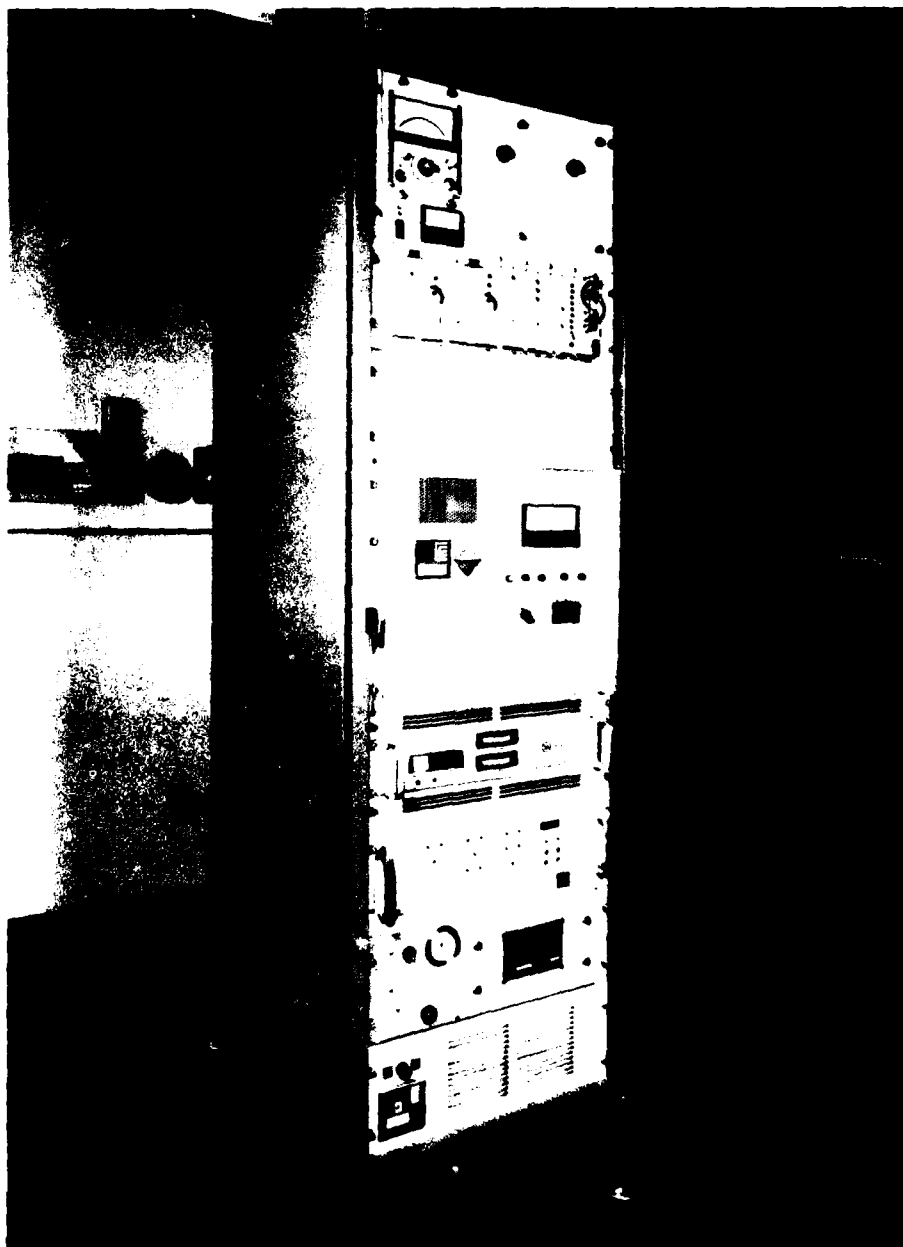


Fig 2 Data terminal



Fig 3 Data terminal antenna

Fig 4

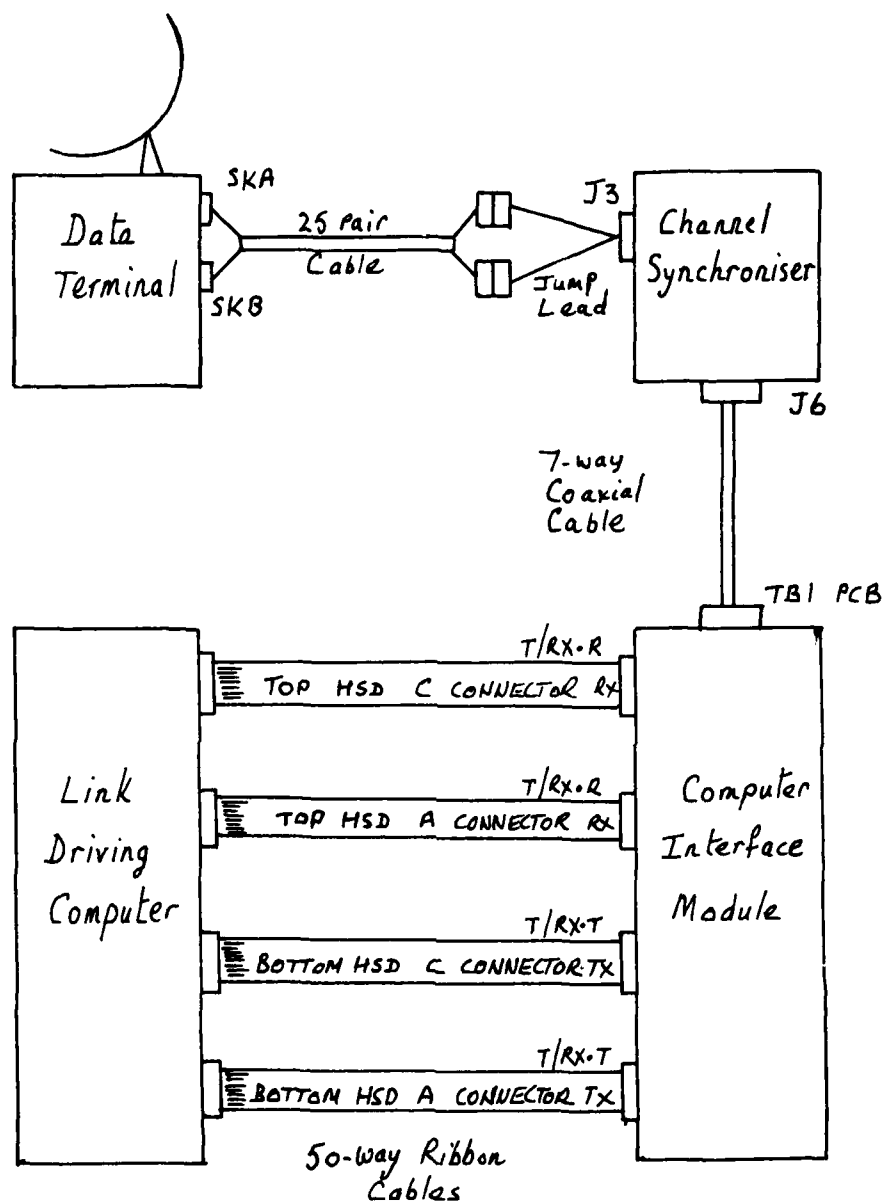


Fig 4 SPINE: Communications earth station

SPINE EARTH STATION OPERATOR'S REPORT

Reporting Station		Call Controller	
Test Name			
Date		Day	
Start Time (GMT)		Stop Time (GMT)	
Satellite		Repeater	Gain Step
Run Codes			
Modem Data Rate (Mb/s)			
CIM D3 Setting (HEX)			
Channel Synchronizer Settings			
Loc/Rem			
Act/Pass			
Clock 1X/2X			
Data Rate 500 kHz/1MHz			
Sync Burst Slave/Master			
Data Burst Timings: (Octal)		D1	
		D2	
Terminal Status			
Tx Power Meter (V)			
Rx Power (dBm)			
HPA Helix Current (mA)			
IPA Beam Current (mA)			
IPA Helix Current (mA)			
Local Weather Conditions			
Environmental Status Recorded?			

Fig 5a Operator's report form (front)

Fig 5b

Communications Software Version		
Test Translator Loop Tested		
Data Transferred		Transfer Time
Line Printer O/P Available?		
Notes		
Operator :		

Fig 5b Operator's report form (obverse)

REPORT DOCUMENTATION PAGE

Overall security classification of this page

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As far as possible this page should contain only unclassified information. If it is necessary to enter classified information, the box above must be marked to indicate the classification, e.g. Restricted, Confidential or Secret.

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17. Abstract As part of the Space Informatics Network Experiment (SPINE) the RAE have installed a data communications earth station to be one node of the network. This Memorandum details the operating procedures for this earth station.					

1/0165

